Chapter 164
Service-Oriented Manufacturing and the Servicizing Transformation of Chinese Manufacturing Industry

Jun Liang and Ting-ting Huang

Abstract In the global manufacturing industry servicizing trend, Chinese manufacturing industry needs transform to service. This paper firstly elaborates the service-oriented manufacturing connotation and its economic effect, on the basis of that, makes classification researches on the product system, which is the service oriented manufacturing realization platform, and further discusses the condition which manufacturing industry transformation need to satisfy, and the obstacles the manufacturing may encounter in the transformation process.

Keywords Service-oriented manufacturing · Manufacturing industry servicizing · Transformation

164.1 Introduction

Since the Reform and Opening-up, Chinese manufacturing industry has made remarkable achievements. However, with the advance of information technology revolution and economic globalization, constantly rising labor and resource cost, increasingly prominent resources and environmental problems, the transformation of Chinese manufacturing industry whose main characteristics are high energy consumption, high pollution, low added value and low efficiency is imperative. In recent years, within the scope of the world, especially in developed countries, the linkage between manufacturing and service industries has become more and more

J. Liang (✉) · T. Huang
Business School of Shandong University,
No. 180 West Culture Road, Weihai 264209, China
e-mail: liangjunsong@sdu.edu.cn

T. Huang
e-mail: 395482046@qq.com

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close, there is a phenomenon of cross-integration of these two industries. Traditional manufacturing enterprises begin to pay more and more attention to the innovation of its business-related service, and service has become a crucial means of competition. Research date of the world's top manufacturing companies from Deloitte and Touche, in 2006, showed that manufactured goods accounted for only about 30 percent of its sales revenue, while service and parts business accounted for more than 70 %. The level of servicizing of manufacturing industry in developed countries is significantly higher than China; in the United States enterprises having manufacturing and service integration account for 58 % of the total number of manufacturing enterprises, in Malaysia this ratio is 45 %, Belgium is 37 %, while in China enterprises with capability of service-oriented manufacturing account for only 2.2 % of all enterprises. The integration of manufacturing and service industries is the product of further division of the world economic system, and it will cause great changes of the global value chain and repartition of interests and control. Facing the trend of servicizing of global manufacturing industry, Chinese manufacturing industry also needs to conduct service transformation.

164.2 Connotation and Economic Effects of Service-Oriented Manufacturing

Berger and Pappas proposed the concept of Service Enhancement, and pointed out that the service of manufacturing sector had become a trend in developed countries. White proposed the word "servicizing", using this word to describe the trend of manufacturing industry, considered that "servicizing" is a transformation of the manufacturer's role from goods provider to service provider and is a dynamic changing process. Vandermerwe and Rada further used "servitization" to describe servicizing that manufacturing companies which only provide goods or goods with additional services transform to provide "goods-service bundles", complete "bundles" including goods, services, support-service, self-service and knowledge, and service is in a dominant position in the entire "bundles" and is the main source of value-added (Vandermerwe and Rada 1988). Szalavetz thought can use "tertiarization" to express servicizing, specifically including two meanings: one is that internal service efficiency become more and more important for manufacturing enterprises, and part of enterprise competitiveness comes from the effective organization and providing of the internal service; the other one is that for customers, the complexity and importance of the external services related to goods is growing, and service will improved the value of goods and the sales.

Chinese scholars such as Linyan Sun believe, service-oriented manufacturing is a kind of high effective and innovative manufacturing mode which aims to realizing value-added of various stakeholder in manufacturing value chain, through amalgamation of products and services, customer involvement in entire process

and enterprises provide productive services and service productions each other to actualizing integration of decentralized manufacturing resources and high degree of synergy of respective core competitiveness and realize an effective innovation manufacturing mode (Sun et al. 2007). This model emphasizing specialty, division, collaboration, is an outcome of mutual support and penetration of the manufacturing value chain and service value chain. In terms of form, the service-oriented manufacturing means that service integrates into the whole process of the product life cycle, such as customer requirement investigation, product design, manufacturing, marketing, after-sales service, etc., or provide customers with personalized total solutions. Service-oriented manufacturing mode enables all links of the value chain as value-added links, and makes the pattern that the traditional manufacturing sector being in the bottom of the "smile curve" mode to change.

The concept of service-oriented manufacturing mainly includes three components: productive services, service production and customer full participation (customer involvement in entire process). Productive services refer to market-oriented intermediate inputs service, which are used for further production of goods and services, non-final consumption services (Wang 2006). Most of the productive services are in the upstream and downstream links of the value chain, expand and extend the traditional manufacturing value chain. Service productions means that enterprises outsource parts or all of the manufacturing sector to specialized manufacturers. Service production activities strengthen the division of labor among enterprises in the middle of the manufacturing value chain, and enable businesses to find a manufacturing resource having comparative advantages, reduce costs, increase production flexibility and reduce risk (Zheng and Xia 2006). Customer full participation refers to the customer involving throughout the production and passing process of manufacturing and service, and having a large number of interactive activities with employees, so companies can find customer demand more quickly. During the procession of customer full participation, businesses and customers can establish a stable relationship forming customer lock-in effect, bitterly dip and share tacit knowledge.

Different from the traditional manufacturing mode, in service-oriented manufacturing mode, there is not a one-time transaction between the customer and the enterprise, but with additional full life cycle services; on the pattern of operation, in addition to the concern of the ways to reduce costs, this mode focus more on demand management and service capabilities, pay considerable attention to knowledge base and knowledge management system which are conducive to knowledge sharing; on the organizational pattern, no longer blindly pursue the vertical integration of the chain structure, but rather focus on the customer, collaboration and interaction between different types of main bodies such as productive service companies, service production enterprises to form a network mode with dynamic structure (Li et al. 2010); service-oriented manufacturing has extended the traditional manufacturing value chain, while shortened the single enterprise's value chain, as every enterprises is focusing more on enhancing its own core competitiveness. Service-oriented manufacturing will bring cost

advantage (Yu and Gao 2011), differentiation advantage (Zhou and Yu 2011), environmental effects (Chen and Ye 2009) and economic effects (Gu and Xia 2010), etc.

164.3 Implementation Platform for Service-Oriented Manufacturing: Product Service System

Product Service System, PSS refers to a range of integrated systems of products and services which can satisfy customer demands. Relying on the PSS, service-oriented manufacturing enterprises provide customers with no longer a pure product or service, but "product × services", thus deliver greater value to customers. The proportion and constitute of products and services in the PSS vary with the type of industry, customer needs, product characteristics, the financial situation of enterprises and technical conditions. According to different degrees of dependence that competitive advantage depends on products or services and whether property right shift in transaction process, PSS can be divided into the following four categories (Sun et al. 2008).

164.3.1 Product-Oriented PSS

In the Product-Oriented PSS (PPSS), after the deal, the ownership of physical products is transferred from the producer to the customer, meanwhile, the customer will get a service agreement related to the physical products to ensure the maintenance, repair and disposal problems of products, The physical product is the core of the enterprise value, and the provision of services to customers is aimed at improving the efficiency and reliability of products. In this mode, the enterprise will price the service business separately, and services have become additional sources of corporate income.

164.3.2 Solution-Oriented PSS

Solution-oriented PSS (SPSS) is to provide customers with a comprehensive solution which is an integration of products and services to meet customer demand to the greatest extent. Service is the main factor to win the market and profit in SPSS. Such services include customized product design, consulting of complete set of solutions, project implementation and management, as well as a variety of services needed in the process of product use. When related services are highly

dependent on the product, SPSS provider can take the user lockout strategy to lock the user by low-price products and use high price services to achieve profitability.

164.3.3 Apply-Oriented PSS

In the transaction process of Apply-oriented PSS (APSS), property rights of physical production will not be transferred, still owned by the APSS provider. Customers buy the right to use physical products and associated support services in a certain period of time to meet their own demand. Product quality and cost have a direct impact on customer experience and price, so the physical product is still the key elements of market competitiveness of the APSS. Nowadays, APSS widely present in the following product area with the characteristic of high-tech, high investment, the use of which limited to particular time and region, such as the large medical equipment, engineering equipment, containers and others l.

164.3.4 Utility-Oriented PSS

In the transaction of Utility-oriented PSS (UPSS), the service producer still has the property rights, while the customer does not use the "product", but directly receive the utility in some form of output, for example, customer purchasing laundry services. The service producer use physical products to provide customers with utility. The UPSS liberates customers from the tedium of learning and the use of complex products, and this is conducive to improving efficiency.

PSS provided by service-oriented manufacturing is not static but in constant evolution. In the beginning of the manufacturing industries, due to lack of experience, in order to reduce the risk many enterprises choose to provide PPSS, after that with the increasing of the service experience, enterprises can begin to provide SPSS or APSS, if the value of the product is relatively small, whether transfer the ownership or not is not pivotal then the differentiation between SPSS and APSS is no longer important, and the UPSS is the ultimate evolutionary target of the PPSS, SPSS, and APSS. Manufacturing companies' provision from PPSS to SPSS, APSS, to the end UPSS is a constantly upgrading process, at the same time, more and more value is created by service. Not all manufacturing companies' transformation need to go through the whole process, enterprises should make choice according to their own characteristics and financial conditions and even for the same products of a particular enterprise, different PSS can be provided to customers with dissimilarity in demand and ability to pay.

164.4 The Basic Conditions of Servicizing Transformation of Manufacturing Industry

Service-oriented manufacturing has many benefits, whether for macroeconomic, resource, environment or micro-enterprises, does this mean that we should encourage all manufacturing sectors and enterprise to implement servicizing transformation? From the practical experience of the developed countries, manufacturing sectors carrying out servicizing transformation have certain characteristics, not all of manufacturing sectors are suitable for the transformation of servicizing.

According to the value differences of physical products and intangible services provided by sectors, manufacturing can be divided into four types, as shown in Fig. 164.1, the different manufacturing sectors have the different manufacturing methods.

For manufacturing sectors which have relatively low value of physical products and intangible services, such as food manufacturing and toy manufacturing, returns gain from servicizing transformation is not high, and they are more suitable for traditional manufacturing mode, through mass production pursuing the scale economy to realize enterprise value.

For sectors like computer manufacturing, household appliance, because of their certain technical content, their physical product value is higher, on the other hand, the operation of those products is less complex, more simple services such as after-sale repairing and maintenance services are needed, therefore, additional value of intangible services is low. Such sectors can only engage in R&D and product design, and carry out mass customization and manufacturing outsourcing, IBM, Haier Group are examples of this kind of successful transformation.

For fashion, furniture and some other manufacturing industries, although the technical content is low, but because the product has the characteristics of short life cycle and fashion, and the customer usually has strong personal special demand, these industries need much more tacit knowledge of the design capability

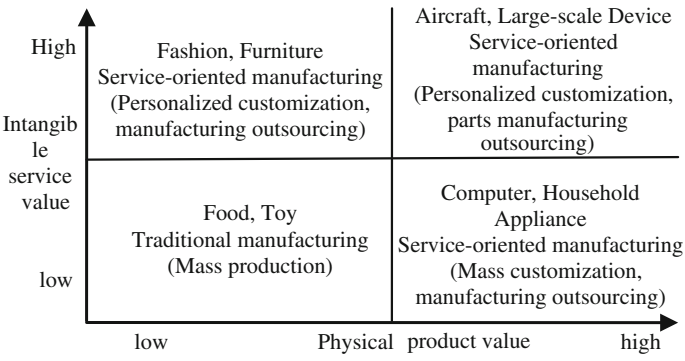

Fig. 164.1 Different manufacturing methods for different manufacturing sectors

and art appreciation based on experience, so those sectors belong to the type with high value of intangible services and low value of physical products and is suitable for customization. They can only provide design services and outsource manufacturing, the Metersbonwe Company is a successful example.

Industries such as aircraft, large device manufacturing, whose physical products have considerable high technological content, complex operation and high degree of product complexity, require more maintenance, repairing and other routine services, should provide services throughout the product life cycle, as a result, both physical products and related intangible services process have the high value. This kind of industries can provide personalized customization according to customer demand, excepting the links of the core technology should be preserved, the rest links, like manufacturing parts can be outsourced, Shaanxi Blower (Group) CO.LTD and General Electric Company are such transformation enterprises.

Through the above analysis, we can conclude that the manufacturing which has transformed into service-oriented manufacturing needs to have the following characteristics: First, the high physical product value due to the high technological content or high complexity of products; second, high intangible service value due to the high complexity, which enterprises need to provide services within the entire product life cycle or need more tacit knowledge or higher design capacity. Only when the manufacturing sector has at least one characteristic and returns from servicizing transformation is relatively high, the manufacturing sector will have the inherent transformation motivation.

164.5 Potential Obstacles of Servicizing Transformation

164.5.1 Obstacles Related to Value Chain

The relationship between the value chain links will hinder the implementation of the strategy of servicizing to some extent (Mont 2002). First, usually servicizing will reduce the number of sales of the product, thereby undermining the interests of the retailers who rely on selling more products to make profits. Second, at the beginning, it is difficult for customers to accept the PSS, in order to enable customers to receive PSS companies need to provide much more attractive solutions, or at least provide products with function equal to the original ones (Meijkamp 1999). What's more, many customers do not know the actual cost of every stage of the product life cycle and thus unwilling to accept the PSS.

164.5.2 Competitive Cost and Operating Cost Obstacles

After transformation, manufacturing companies begin to provide services for customers, this means that the enterprises have entered a new competitive

area-service area. There are many competitors in this area, and in order to survive in the new competitive environment, manufacturing enterprises must establish their own competitive advantage which will bring competitive costs (Mathieu 2001). In order to meet individual needs of customers, companies need to provide more modules and channels to keep in contact with customers, and have to establish demand management system and knowledge management system, as a result, increase the operating costs of enterprises. In order to provide better services, companies need to find and identify customer demand and need to offer continual specialized training for staffs to increase their sense of service and their service capabilities, thereby will increase the operating costs. In addition, to provide more services will inevitably bring about the increase in unit labor costs, enterprises have a certain degree of difficulty in measuring costs and value of providing services, and it will take a long time to determine customers' charge standards.

164.5.3 Concerns About Risk

In practice, the risk of servicizing transformation that manufacturers tend to imagined is often much more serious than the actual situation, therefore they sometimes do not willing to internalize the cost of using product, especially in the case that they can't affect the consumers' using behavior. Enterprises will have cash flow uncertainty risk when transform short-term profits from the sale of goods into medium and long term profits from providing services (Oliva and Kallenberg 2003). In addition, companies do not believe that the provision of services can bring additional economic benefits, or the enterprise think providing services may have exceed the limits of their capacity, these matters also will hinder the servicizing transformation (Oliva and Kallenberg 2003).

164.5.4 Organizational Resistance to Change

There is often a conflict of business mode in the enterprise having both products sales and services provided. Servicizing transformation will pose threats to some organizations, when organizations believe service-oriented transformation may change their authority, proprietary technology, responsibilities or resources, they will oppose servicizing transformation (Li et al. 2009). To conduct servicizing transformation, companies must spend necessary costs to deal with and resolve these conflicts.

164.6 Conclusion

Chinese manufacturing enterprises in pass of transformation and upgrading, should closely follow the trend of global manufacturing servicizing, deeply understand the connotation of service-oriented manufacturing, actively create basic conditions for transformation of manufacturing industry, fully estimated the potential difficulties may be encountered in the transformation process, implement the manufacturing servicizing transformation to win economic effect of service-oriented manufacturing.

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References

Chen Y-Y, Ye L-Z (2009) Environmental effects of manufacturing servicizing (in Chinese). Commercial Res 52(8):59–62

Gang Li, Lin-Yan Sun, Jian Li (2009) Origin, conception and value creation of service-embedded manufacturing (in Chinese). Sci Technol Prog Policy 26(13):68–72

Gu N-H, Xia J-C (2010) Economic effects of foreign trade and manufacturing investment servicizing—empirical research based on the 2007 input-output table (in Chinese). Soc Sci Res 32(5):17–21

Li G, Sun L-Y, Gao J (2010) Architecture and implementation of service-embedded manufacturing (in Chinese). Sci Technol Prog Policy 27(7):45–50

Mathieu V (2001) Service strategies within the manufacturing sector: benefits, costs and partnership. Int J Serv Ind Manag 12(5):451–475

Meijkamp R (1999) Changing consumer behavior through eco-efficient services: an empirical study of car sharing in the Netherlands. Bus Strategy Environ 7(4):234–244

Mont OK (2002) Drivers and barriers for shifting towards more service-oriented business: analysis of the PSS field and contributions from Sweden. J Sustainable Prod Des 2(3-4):89–103

Oliva R, Kallenberg R (2003) Managing the transition from products to services. Int J Serv Ind Manag 14(2):160–172

Sun L-Y, Li G, Jiang Z-B, Li Z, He Z (2007) Service-embedded manufacturing: advanced manufacturing paradigm in 21st century (in Chinese). China Mech Eng 18(19):2307–2312

Sun L-Y, Gao J, Zhu C-Y, Li G, He Z (2008) Service-oriented manufacturing: a new product mode and manufacturing paradigm (in Chinese). China Mech Eng 19(21):2600–2608

Vandermerwe S, Rada J (1988) Servitization of business: adding value by adding services. Eur Manag J 6(4):314–324

Wang J-R (2006) Research review of producer services at home and abroad (in Chinese). Market Modernization 35(35):39–40

Yu A-P, Gao W (2011) Cost advantage and its formation mechanism of service-embedded manufacturing (in Chinese). J Nanjing Univ Finan Econ 29(5):30–34

Zheng J-C, Xia Q (2006) Production servicing business and the division of labor (in Chinese). Sci & Technol Prog Policy 22(2):13–15

Zhou J-F, Yu A-P (2011) Differential advantage for service-oriented manufacturing and its formation mechanism (in Chinese). Sci Technol Prog Policy 28(23):39–41